INDRO ROBOTICS "DRONES FOR GOOD" PROJECT

INDRO ROBOTICS
REMOTELY PILOTED AIRCRAFT SYSTEM
STANDARD OPERATING PROCEDURES

Prepared for

InDro Robotics Inc.
Salt Spring Island

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PREAMBLE

This document has been prepared to support remotely piloted aircraft system operations at InDro Robotics Inc., with offices at Salt Spring Island, British Columbia, Canada. The following two major parts are included in this manual:

a. Standard Operating Procedures (SOPs); and
b. Remotely Piloted Aircraft System (RPAS) Flows and Checklists.

In addition to providing RPAS company SOPs for employees and associates, this document and the related InDro Operations Manual and Training Manual provide data required to support safe operational use of InDro's RPAS.

These SOPs have been compiled for the use and guidance of InDro operations personnel to execute their duties. They contain information and instructions on how company operations shall be conducted. The standards, practices, procedures and specificationscontained in this document reflect the company's operating policies and are in accordance with the laws and regulations of Canada and the United States of America.

All personnel concerned with the conduct of company operations are to apply the SOPs contained in this manual during flight operations. Therefore, this manual will be distributed to all operations personnel,who will familiarize themselves with its contents, and apply the SOPs laid out herein.

Where reference in this manual is made to the "Company" and/or the "Operator", it shall be taken to mean InDro Robotics Inc.

Note:

- The use of CAA through this document is to achieve generalization, avoid duplication and maintain a single source of truth on how to operate RPAS following Indro procedures and CAA approved operations. Additionally, references to TCCA regulations and FAA regulations are made to highlight specific requirements throughout this document.
- RPAS and sUAS are used interchangably in this document, and there is no distinction between the meaning of both acronyms.

MANUAL AMENDMENT PROCEDURES

Manual amendments will be promulgated as required by the Operations Manager. After acceptance and approval by InDro, they will be issued to each manual holder.

It is the responsibility of the manual holder to insert all amendments issued to them promptly and ensure all manual pages are consistent with the List of Effective Pages. The Operations Manager will amend manuals published to each Unmanned Aircraft System (UAS). Each amended page shall record the appropriate amendment number and date.

Any discrepancy between the List of Effective Pages and the actual manual pages will be brought to the attention of the InDro Operations Manager immediately.

MANUAL HOLDERS

Manual Copy	Manual Holder	Address	Telephone
Master	Operations Manager	Unit 100, 334 Upper Ganges Road, Salt Spring Island, BC, Canada V8K 1R7	250-931-3933
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Copy 2	With Aircraft		
Copy 3			

RECORD OF AMENDMENTS

NOTE

The portion of the text affected by the latest change is indicated by the standard Word designation of tracked changes, including vertical bars at the side of the page, strike throughs, underlined text and text colour changes.

The date of issue of original and amendment list pages are contained in the following table.

Identification of Change		Date Entered	Responsible Person
Amend. No.	Date		
Original Issue	25 July 2016	Not Applicable	Not Applicable
Amendment 1	18 September 2018	18 September 2018	Bob Kobierski
Amendment 2	5 December 2018	5 December 2018	Bob Kobierski
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Amendment 4	10 April 2020	10 April 2020	Bob Kobierski
Amendment 5	28 April 2020	28 April 2020	Bob Kobierski
Amendment 6	14 May 2020	14 May 2020	Bob Kobierski
Amendment 7	9 July 2020	9 July 2020	Bob Kobierski
Amendment 8	17 July 2020	17 July 2020	Bob Kobierski
Amendment 9	8 October 2021	8 October 2021	Kate Klassen

LIST OF EFFECTIVE PAGES

Page No.	Amendment No./ Effective Date	Page No.	Amendment No./ Effective Date
i	AL-4, 10 April 2020	3-10	AL-9, 8 October 2021
ii	AL-9, 8 October 2021	3-11	AL-9, 8 October 2021
iii	AL-9, 8 October 2021	3-12	AL-9, 8 October 2021
iv	AL-9, 8 October 2021	3-13	AL-4, 10 April 2020
v	AL-9, 8 October 2021	3-14	AL-9, 8 October 2021
vi	AL-9, 8 October 2021	3-15	AL-4, 10 April 2020
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ABBREVIATIONS AND ACRONYMS

Abbreviations and acronyms have been inserted at the beginning of this document for ease of use. Acronyms are used throughout this InDro Operations Manual and the reader is asked to refer to the list below for explanations of these acronyms.

3D	Three Dimensional
AGL	Above Ground Level
AOI	Area Of Interest
ATC	Air Traffic Control
ATS	Air Traffic Service
ATTI	Attitude (mode)
BVLOS	Beyond Visual Line of Sight
C&C	Command and Control
CEO	Chief Executive Officer
CFIT	Controlled Flight Into Terrain
CG	Centre of Gravity
CS	Control Station
CAA	Civil Aviation Authority
DND	Department of National Defence
DoD	US Department of Defence
EMS	Emergency Medical Services
EOC	Emergency Operations Centre
ESC	Electronic Speed Controller
FAA	Federal Aviation Authority
FC	Flight Controller
FSS	Flight Service Station
GPS	Global Positioning System
HAZMAT	Hazardous Materials
IC	Incident Commander
InDro	Industry Drones
LED	Light Emitting Diode
LiPo	Lithium-Polymer
MEL	Minimum Equipment List
NOTAM	Notice to Airmen
P-ATTI	Position-Attitude (mode)
PC	Personal Computer
PIC	Pilot-in-Command
PO	Payload Operator
PREOC	Provincial Emergency Operations Centre
RPAS	Remotely Piloted Aircraft System
RTL	Return To Launch
SD	Storage Device
SFOC	Special Flight Operations Certificate
SI	Staff Instruction
SITREP	Situation Report
SOP	Standard Operating Procedures
TC/TCCA	Transport Canada/Civil Aviation
UHF	Ultra High Frequency
UAS	Unmanned Aircraft System
VLOS	Visual Line of Sight
VO	Visual Observer

1 INTRODUCTION

1.1 GENERAL

This set of Standard Operating Procedures (SOPs) is the primary document used by InDro Robotics Inc. (InDro) to describe standardized flight operations conducted by the company when operating RPAS. It has been prepared to be in accordance with TCCA and FAA requirements, including Canadian Aviation Regulations and FAA 14 CFR Part 107 regulations. These outline the provisions of this manual, and the standards that SOPs must meet. This document has maintained the basic structure and intent of original CAA instructions although the contents have progressed as the capability and functionality of InDro's fleet have matured.

1.2 BACKGROUND

InDro continues developing Remotely Piloted Aircraft System (RPAS) for use in emergency response, disaster preparedness and planning, and other more general airborne photographic activities. As part of this project, manuals and SOPs have been formalised to ensure safe operations and to support InDro's vehicles and crew operations.

1.3 AIM

This document aims to provide SOPs to InDro employees, associates and operators of the InDro RPAS.

1.4 SCOPE

The relevant details associated with the RPAS flown under the auspicious of this SOP document may be found in the various applicable InDro System Flight and Maintenance Manuals, Operations material, Training material, and Maintenance and Servicing Instructions located in InDro's library of documents.

1.5 LIST OF REFERENCES

The following is a list of documents used during the preparation of these SOPs:

A. Canadian Aviation Regulations. (new Part IX).

B. Transport Canada Aeronautical Information Manual, TCCA AIM 2016-1, RPA-REMOTELY PILOTED AIRCRAFT, TP 14371E, effective 26 March 2020, Transport Canada.

C. TP 15395 E (07/2019) Flight Reviewer's Guide for Pilots of Remotely Piloted Aircraft Systems 250 g up to and including 25 kg, Operating within Visual Line-of-Sight (VLOS).

D. 14 CFR Part 107 SMALL UNMANNED AIRCRAFT SYSTEMS

E. FAA AC 107-2A - Small Unmanned Aircraft System (Small UAS) Dated February 121

1.6 STANDARD OPERATING PROCEDURES OUTLINE

This document consists of the following parts:

Part 1 – Introduction. Part 1 provides background information for the document and outlines the aim and scope. This part also includes the list of references.

Part 2 – Standard Operating Procedures. Part 2 contains descriptions of all InDro SOPs including normal operations and emergency operations.

Part 3 – Aircraft Flows and Checklists. Part 3 compliments Part 2 by providing the flows and checklists required for flight operations.

Part 4 – Concluding Material. Standard Operating Procedures concluding comments are contained in Part 4.

Editor's note: The InDro Operations Manual, Training Manual, RPAS Flight, and Maintenance Manuals have been published under a separate cover.

2 STANDARD OPERATING PROCEDURES

2.1 GENERAL

InDro has established and maintains SOPs that have been prepared in accordance with the requirements of CAA regulations. These SOPs are contained herein. InDrowill ensure that a copy of these standard operating procedures is available at each control stationduring flight operations. In each relevant case, the information provided in these SOPs will use standard aviation-related units of measure (e.g., nautical miles per hour (kts), feet (ft), etc.). Theprocedures contained in this section are augmented by the flows and checklists contained in Section 3 of this manual.

2.2 ADVANCED PROCEDURES

2.2.1 Assembly

The routine procedures for pre-flight assembly of the RPAS are detailed in the flight crew flow entitled “RPAS Setup Flow” contained in Section 3 of this manual.
This flow is preceded by the Pack Up Flow that, when followed, will ensure that all required components are made available in the field for the RPAS Setup Flow.

2.2.2 Pre-Flight Tests

Maintenance test flights will be conducted (if required) before releasing the RPAS to operational service. On ground pre-flight tests (Built-in-Test and serviceability tests) will be conducted before each sequence of flights in accordance with the following flows and checklists:

a. Setup Flow;
b. Equipment / RPAS External Inspection Flow;
c. Pre-flight / Run-up Flow; and
d. Pre-Take Off Checklist.

These flows and checklists are detailed in Section 3 of these SOPs.

Note:
1) 14 CFR 107 §107.15 defines that the remote pilot must check that the small UAS is in a condition for safe operation. Section 3 flows and checklist provides the steps-by-steps procedure on how an offsite remote pilot in command interacts with on-site VO to maintain an equivalent level of safety as if the PIC was on-site
2) *14* CFR 107 §107.49 Preflight Familiarization, Inspection, and Actions for Aircraft Operation. Before beginning flight operation, the remote PIC must complete a preflight familiarization, inspection, and other actions, such as crewmember briefings. Section 3 checklists and flow provides an equivalent level of safety to RPIC offsite and provides communication flow with the RPIC offsite and VO onsite.

2.2.3 Weight and Balance Control Requirements

The flight crew will only operate an RPAS after determining that the Weight and Balance are within the acceptable range defined in the specific System Flight and Maintenance Manual. The method used is described in the related Operations Manual. Suitable Weight and Balance will be determined before the conduct of the Pack Up flow and verified or adjusted before launch. If a RPAS is flown with a standard battery and standard payload that the Centre of Gravity (CG) may be judged to be within limits.

2.2.4 On Ground Pre-Flight Safety Procedures

On ground pre-flight safety procedures, as they related to non-flight crew safety, are contained in the Operations Manual.

Safety procedures, as they relate to crew safety are incorporated into the SOPs contained herein.

2.2.5 Take-Off/Launch, Flight and Recovery

The SOPs for RPA flight are detailed in the following flows and checklist which are contained in Section 3 of this manual:

a. Pre-Take Off Checklist;
b. Take-Off Flow;
c. In-Flight Flow;
d. Pre-Landing Checklist; and
e. Landing and Shutdown Flow.

2.2.6 Crew Coordination such as Standard Briefings and Calls and Handovers

Crew coordination for each mission commences with the company standard Pre-Flight Briefing Flow detailed in Section 3 of this manual. Throughout the operation, aviation terms such as: o'clock for direction, height for height above ground or altitude for height above sea level, will be used to avoid miscommunication.

Defined expressions in 2.3.1 such as land as soon as possible, land as soon as practicable and land immediately will be used in the high stress situations associated with emergencies.

Handovers from the Pilot In Command (PIC) to the Visual Observer (VO) and back are completed with first explaining the position (location) and flight condition of the RPA, followed by the words: "You have control" or "I have control", which in turn is followed by: "I have control" or "You have control" (alternately, "You have the con" and "I have the con" may be used). Each time the pilot changes the flight mode of the autopilot while the aircraft is in flight, this shall be announced verbally to the rest of the flight crew.

2.2.7 Balked Action Procedures

If a balked landing or other arresting action is required due to events that necessitate flying the RPA from the landing location, obstruction or not flying closer to the landing location or other flight risk, the PIC or VO who first becomes aware of the obstruction shall issue the command: "STOP, STOP, STOP". They will then issue the command to either: "GO AROUND or HOLD POSITION" as required.

2.2.8 Refuelling/Battery Charging or Replacement

InDro RPAS are all powered by Lithium-Polymer (LiPo) battery packs and as such there is no requirement for refuelling the RPAs. Battery charging is completed with due regard to safety during this hazardous procedure. Battery voltage levels are monitored closely during flight operations, using the Go App (if used, or some other equivalent application or electrical system), to ensure that the voltage does not decrease below a safe level (20% voltage remaining). In addition, battery cells are balanced and remain balanced to ensure that one cell does not receive an overcharge. The company policy is that a person should be present at all times during the battery charging process. The operator will ensure that the charging protocol matches the capability of the battery. A fire extinguishing container (steel box) will be made readily available

in the event of a battery fire. The battery recharging flow is contained in Subsection 3.2.13.

During flight operations the PIC will ensure safe replacement of the battery(s) by disarming the RPA using the throttle on the hand controller before anyone approaching the vehicle and subsequently depressing safety switch(s) (if installed) before handling the RPA. A hands clear protocol shall be used by the pilot holding the hand controller. The reverse process is used to re-arm the vehicle. Before attaching the recharged battery, the voltage of the replacement battery will be verified as suitable for the mission.

2.2.9 Use of Checklists

It is InDro policy that when a normal procedure checklist (as opposed to a flow) is provided by InDro to the flight crew, then the checks listed in the checklist will be voiced as a “cross-check and verify” sequence rather than as a “challenge and reply” sequence. That is to say, the VO will read the left item of each check, the PIC will verify that the item has already been selected or checked and will voice his or her verification that the item has been selected or checked correctly. However for emergencies, the opposite is true. The checklist will be used as a “challenge and reply” do list,the VO will read the left side of the check and the PIC will complete the item and “reply” that it hasbeen completed.

For operations conducted BVLOS, the cross-check and verify sequence will include a complete review of the mission settings including contingency settings by the back-up pilot.

2.3 ABNORMAL AND EMERGENCY PROCEDURES FOR ADVANCED OPERATIONS

Training is required on an annual basis and shall include instruction on the operation of all emergency equipment, including:

a. RPA fire in the air and on the ground;
b. use of fire extinguishers including practical training;
c. operation and use of emergency landing including practical training;
d. spectator preparation for an emergency landing including practical training;
e. PIC incapacitation including practical training;
f. radio procedures for flyaway (VLOS) and loss of containment in operational volume (BVLOS) including:
    - mock class G “PAN PAN” calls
    - mock calls to ATC;
g. control hijacking, interference and other security procedures; and
h. special emergency procedures when the RPAS is used on Emergency Medical Services (EMS) operations including emergencies.

2.3.1 Emergency Landing / Recovery

The most common modes for flight operations are Position (GPS) Hold Mode and Function Mode. If these modes degrade due to a flight controller malfunction, the pilot will be required to conduct an emergency landing using a less stable flight mode such as Attitude (ATTI)Mode. It is InDro’s philosophy is that their pilots will be trained to fly the RPA in ATTI Mode to the extent required to conduct an emergency landing.

Emergency landings may be directed as “as soon as practical”, “as soon as possible/ASAP”, or “land immediately”. They are defined as follows in order of urgency hierarchy.

1. Land Immediately – The pilot should immediately take action to reduce altitude and land at the current ground position or terminate the flight as per the flight termination procedures.

2. Land ASAP – The pilot should land at the nearest, suitable landing site. No reasonable landing area should be overflown en route to a more convenient location.
3. Land as soon as practical – The pilot should take action to identify and land at the nearest operationally convenient location.

In an emergency where the RPA must land urgently, the RPA will be piloted to ensure the safety of all structures and people, including crew. It is essential that the aircraft remain within Visual Line of Sight (VLOS), so the landing is controlled at all times. Crew members will be immediately notified to prepare for an emergency landing. The Operations Manager will ensure the safety of all crew and bystanders during the emergency using ground communications. The Emergency Landing / Recovery checklist is contained in Subsection 3.4.2.

2.3.2 Equipment Failure and Return to Launch

a. **Main Control.** In the event of a primary control failure (Ultra High Frequency (UHF) transmitter or receiver), the PIC shall be familiar with the specific actions the aircraft will take. These are detailed in the respective InDro System Flight and Maintenance Manual. For example, if selected in advance, DJI aircraft will hover in place for up to 3 seconds waiting for control to be regained.

b. **Continued Control.** If no control is initiated, the aircraft will automatically initiate an action such as flying backto the original take-off (home) location at the pre-set height above the take-off elevation and slowly descend vertically until on the ground. Global Positioning System (GPS) is used to navigate the aircraft back to the take-off/landing (home)location.
For BVLOS operations, the routes flown in a Return to Launch procedure must be calibrated in advance to ensure the aircraft remains within the operational volume specified for the flight.

2.3.3 RPAS Equipment Failure

a. **Battery.** An intelligent battery setup prevents the RPA from departing controlled flight in the event of a single cell failure. A warning will be issued on theGo App or equivalent application. A visual “twitch” or sudden loss of altitude may occur if a single battery cell fails. The aircraft is to be manoeuvred to a location free of bystanders for an immediate emergency landing.

b. **GPS.** If the GPS loses signal during a flight, the flight control will automatically switch to “attitude (P-ATTI)” mode or equivalent, requiring direct input from the pilot to navigate the RPA. Position hold will be lost. If possible, the RPA will be piloted back to theoriginal take-off/landing area, or an emergency landing may be carried out in accordance with the urgency levels identified in 2.3.1.
Extra consideration will be required for BVLOS operations as the pilot must have the ability and flight conditions to return the aircraft to a home point while remaining within the operational volume. If such conditions do not exist, an emergency landing may be carried out in accordance with the urgency levels identified in 2.3.1.

c. **Gyro / Accelerometer / Barometric Altimeter.** In the event of sensor failure, the aircraft must be piloted in “Manual” mode. No stability or altitude hold will be present, and if possible, the RPA will be piloted back to theoriginal take-off/landing area, or an emergency landing may be carried out in accordance with the urgency levels identified in 2.3.1.

Extra consideration will be required for BVLOS operations as the pilot must have the ability and flight conditions to return the aircraft to a home point while remaining within the operational volume. If such conditions do not exist, an emergency landing may be carried out in accordance with the urgency levels identified in 2.3.1.

d. **Motor / ESC.** In the event of a motor or Electronic Speed Controller (ESC) failure, the RPA will act erratically. It may remain airborne and in control. The RPA must be piloted in at a slow pace back to the original take-off/landing location, or to the alternate landing area. Total loss of control must be anticipated at any time; therefore, the RPA must not be flown near spectators or flight crew.

e. **Flight Control.** In a catastrophic flight control failure, the aircraft will crash. No signal will be given to the ESCs for power and the aircraft will drop suddenly. A malfunction could also cause the RPA to “fly-away”. A properly planned flight using applicable software controls and safe operating procedures play a key role in ensuring bystanders are not harmed and property is not damaged. Flight testing is essential to ensure the proper operation of the flight controller in this situation.

2.3.4 Ground Station Equipment Failure

a. **Battery.** In the event of a battery failure on ground station equipment (tablet, phone or computer device operating the flight control software), the powered device will shut off. If any battery fails during a flight operation, the RPA will fly to the home location and land. The RPA will land immediately if the battery can only support the landing.

b. **Video Receiver.** Live video is not required for a successful operation, but, for VLOS operations, is a secondary source of flight profile information and detailed orientation. The aircraftwill be piloted back to the original (or alternate) take-off/landing location for inspection in the event of the loss of video feed.

c. **Phone / Communications.** InDro flight operations will not take place if communication with a required controlling agency is not present via cell, satellite or reliable long-range radio. If voice contact is lost during a flight or the communication equipment malfunctions, the flight will be terminated ASAP.

2.3.5 Control Station Failures

In the event of a Control Station (CS) (tablet or computer device operating the flight control software) failure (e.g., lossof power, software, hardware, etc.), control of the RPA will automatically switch to the functioningserviceable control device (either hand controller, or the Flight Controller’s (FC’s) built in Return to Launch (RTL) function).

2.3.6 Communications Failures

In the event of a loss of cellular communication, where such has been required by ATC in the flight authorization, the PIC will immediately control the RPA to the original take-off location, land as soon as practical and attempt to regain communication. The flight will be terminated until such a time as the communications failure is resolved.
Upon failure of communications with crew, repositioning of crew to achieve communication goals is necessary to ensure continued flight safety, particularly when VOs are employed to maintain line of sight requirements.

2.3.7 Command and Control Link Failure

In a command and control link failure the RPA will stop responding to PIC control inputs. The PIC will refer to the Command and Control Link Failure emergency checklist in Subsection 3.3.5 to determine the checks to be conducted.

Communication disconnects, whether cellular or RC, are detected by the system and are reported to the pilot. The flight control software allows for pre-selected actions in the event of a loss of C&C link exceeding a pre-set threshold, such as the RPAS gaining altitude to the Operator pre-set Return to Launch height and an RTL initialization. Alternately, as preselected by the pilot, once the communication link is lost the RPAS could establish an extended hover or land. The preferred selection is RTL so that the communication link can be regained. Once the RPAS and hand controller have re-established the communication link the pilot may regain control of the air vehicle using standard selections on the ground control station. There are settings for the RPAS that must be pre-set by the operator prior to flight:

a. RTL transit height; and
b. RPAS response in the event of a communication link failure (hover, land or RTL).

In the event the cellular communication link is lost, the RPAS will pause the flight mission and wait. The communication signal may drop as the aircraft gains a new IP address in the transition between cellular towers. If the signal does not return within a reasonable amount of time, and the RPAS is within radio communication range, the PIC will enable RC control to return the aircraft for a landing as soon as practical. The PIC is able to set an upper limit for the reconnection wait time to suit the flight scenario. A default time of 10 seconds is recommended if the scenario does not suggest otherwise. If the RPA is outside of RC range and the cellular connection is not able to be regained, the RPA will attempt an RTL based on known GPS position of take-off and as a last resort, can conduct an emergency landing at its current location.

2.3.8 Loss of Visual Contact

If visual contact with the RPA is lost during VLOS flights, the crew will start procedures to regain visualcontact and if unsuccessful they will treat the situation as a "fly-away". The emergency checklist for Loss of Visual Contact is contained in Subsection 3.3.6.

2.3.9 Pilot Incapacitation

For direct radio-link flight, InDro pilots comply with the company policy that a designated switch on the hand controller initiates an RTL function.
For cellular enabled flight, InDro pilots comply with the company policy that the ground control software will be programmed to enable activation of an RTL function. All flight crew members are trained to activate this RTL selection in the event of impending or actual pilot incapacitation.

2.3.10 Potential Conflict with other Aircraft

Aircraft separation and collision avoidance will be of the most serious concern to the InDro flight crew, including the pilot, VO and if present the Operations Manager. InDro pilots comply with the company policy and CAA regulations that directs them to give the right of way to all manned aircraft. Radio communications will be used to alert aircraft in the area when applicable, including the use of PAN PAN broadcasts in the event of a loss of control.
In the event that an aircraft is heard but not seen the pilot must land the RPA as soon as is practical. When landing is not practical the RPA will reduce altitude to the lowest safe level while

maintaining connectivity and ability to maneuver, ideally to the same height as trees or buildings in the proximity. During the launch and recovery portion of the flight, awareness of other RPAs will be paramount; especially a lookout for electrically powered fixed wing aircraft which are very quiet on approach and landing. When en-route, especially during waypoint navigation at the edges of operational VLOS or BVLOS contingency volumes, a lookout for low flying aircraft, especially helicopters, must be maintained, this will include VO with binoculars and RPA FPV camera system, as applicable. Blind and directed radio calls will be made at intervals during BVLOS flight.

The right of way rules that are used by pilots of manned aircraft will be used when two RPAs interact in flight.

2.3.11 Return to Launch System

If a flight needs to be terminated due to a control problem, the RPA will be returned to the home location, the hand controller or ground control software can trigger the flight controller RTL function. In the event of a control link failure, the flight controller will automatically trigger the RTL function and land at the last programmed home location.

2.3.12 Fly-away RPA

Fly-away means, with respect to a remotely piloted aircraft, an interruption or loss of the command and control link such that the pilot is no longer able to control the aircraft and the aircraft no longer follows its preprogrammed procedures or no longer operates in a predictable or planned manner. PICs will only operate an RPAS with the relevant site survey immediately available to each crew member. The completed site survey will contain details recording and identifying the present position and the contact information for the Flight Service Station (FSS)/ATC, Area Control Centre (ACC) or Flight Information Centre (FIC), as appropriate.

Note: PICs must be aware that the detailed contact information and the means of contact (usually a cell phone) must be within effortless reach. For example, the fly-away contactinformation may be kept on a lanyard around the pilot's neck.

If there is inadvertent flight into controlled airspace, airspace which was previously identified by the PIC during pre-flight procedures, as indicated through visual observation by the PIC or the observer, and/or a fly-away occurs, the ATS Unit noted in the PIC pre-flight procedures (FSS/ATC or FIC) will be notified and efforts to regain control of the RPA will be continued.

Prior to the notification call, the PIC will, without delay: identify and record the present position of the flight crew; identify and record the direction and altitude the RPAS was last seen travelling; and estimate the approximate flight time remaining in the power supply and the time at which this estimate is valid. If time is available, the PIC will also estimate the approximate available flight time that will remain with the power on board upon arrival at the destination.

Sample Notification Call:

- PAN PAN, PAN PAN, PAN PAN
- This is a remotely piloted aircraft, remotely piloted aircraft, remotely piloted aircraft
- Experiencing a loss of control fly away
- Climbing through 500' AGL
- 6NM northwest of Grand Lake and northwest bound
- Aircraft is a grey quadcopter and weighs 15 kilograms with a two foot rotor span

Within two minutes after control is lost the responsible person (PIC) will:

a. contact the appropriate air traffic control unit(s);
   - Tower first, then ACC unit as necessary
b. broadcast a PAN PAN call if in Class G airspace;
c. contact emergency services as necessary;
d. review the Flight Itinerary;
e. begin a search; and
f. contact the Operations Manager

The Operations Manager will:

a. verify that contact has been made with the nearest FSS/ ATS or FIC;
b. continue the search; and
c. carry out any other duties determined by the Company.

2.3.13 Unlawful Command and Control Link Interference

In the event of unlawful interference at the ground station, the flight crew shall endeavor to notify the appropriate ATS unit of this fact and convey any significant circumstances surrounding the event in order to allow ATS to prioritize the event and minimize any conflict with other aircraft. Unlawful interference of the communication channel with the aircraft will be treated as a lost link.

If subject to unlawful interference, the flight crew shall endeavor to maintain assigned track and altitude until able to notify ATS.

2.3.14 Flight Termination System

If continued flight of the RPA is judged to be a hazard to persons or property the PIC will engage the flight termination system provided that by doing so, the safety of other airspace users and those on the ground will not be compromised. Several flight termination systems exist such as parachutes, RTH or a forced shutdown. In the latter, the system will initiate an immediate uncontrolled descent due to complete disconnection of system battery power. On some systems, flight termination is affected by holding the throttle control at the very bottom (cut-off) inside position and at the same time therole/pitch control to the lower inside position. This stops the rotors in flight, initiating tumbling of the RPA on a ballistic trajectory. This control input is called the hand controller Combination StickCommand (CSC); see the relevant InDro System Flight and Maintenance Manual. Please note that this control input is identical to the “arm command” used to start the rotors on many InDro RPAS. PICs are required to verify the procedures used, with the aircraft employed for flight, are correct and understood before the flight.

2.3.15 RPAS Accident

In the event of an RPAS accident, the responsible person (PIC or Operations Manager) will coordinate and action on-site assistance as necessary:

a. secure the aircraft to prevent further damage and injury;
b. ensure any injuries receive first aid and/or transportation to a hospital as required;
c. contact Air Traffic Services as appropriate;
d. document the incident and actions taken;
e. contact fire departments; and if necessary
f. contact police.
g. contact the Transportation Safety Board if the accident is serious (i.e. causes death or a collision with a manned aircraft.)

The PIC will contact the Operations Manager, and the Operations Manager will, in accordance with the InDro Operations Manual, contact the corresponding CAA and the correspondeing Transportation Safety Board, if appropriate. Documentation records of the accident will be retained internally for 12 months. Adjustments to SOPs to be made following internal accident investigation to limit the possibility of a similar incident from occurring in the future.

2.3.16 Emergency Control Station Evacuation

InDro employs open control stations (hand controller in the field) or standard office space for the Home Station. In this case, normal building evacuation procedures will be used for emergency egress from the RPAS Home Station. If the flight control device is portable, the PIC will endeavour to retain this device during evacuation or initiate an emergency landing sequence so long as it does not risk the safety of themselves or other crew members.

2.3.17 Operations at Advertised Events

InDro SOPs for First Responder operations at advertised events are as follows:

a. The organizers of an advertised event often call upon First Responders to assist with the planning and on-site medical needs of advertised events of all sizes throughout the province. As a result, the RPAS team may be called upon to operate the RPAS.

b. As per Part IX of the CARs, "… the pilot shall operate the RPAS in accordance with any additional limitations or restrictions provided by the Advertised Event Organization."

c. RPAS crews shall coordinate with event staff to ensure all limitations or restrictions are complied with per CAA approval. As listed in the CAA Aeronautical Information Manual, an SFOC is required when operating less than 100 feet from the boundaries of an advertised event per provision of the CAA. The perimeter of such events (outdoor events such as concerts, performances, festivals, markets, or sporting events, etc.) are limited by perimeter fences and at the gates where event personnel restic people, volunteers, and security or peace officers. Where no such perimeter is defined for outdoor advertised events, it is expected that the boundaries of the advertised event be at least 100 feet from people participating in the advertised event and 100 feet from the track of the sporting event for all categories of RPA pilot certificates and models of RPAs.

d. Should the need arise for BVLOS operations, the crew shall follow the established procedures for BVLOS.

e. The RPAS will be operated at a safe altitude to provide optimal coverage of the venue and limit its maneuverability to areas secure from pedestrian and vehicular traffic unless a need arises for a better vantage point of a serious and potentially life-threatening event.

2.3.18 Flights over 400 feet Above Ground Level

InDro SOPs for First Responder operations at heights above 400 ft AGL are as follows:

a. Flights over 400 feet AGL pose an increased risk to manned aviation and shall be limited to "exceptional or exigent" circumstances.

b. Knowledge of the airspace is crucial and the RPAS crew must remain vigilant of any conflicts that the operation may pose with manned aircraft.

c. Radio calls shall be broadcast with position reports and altitude AGL, with emphasis in the call on the AGL number. (ex. “500 feet AGL” not “500 feet”)

d. Should a potential conflict with manned aircraft arise, the RPAS shall descend immediatelyto a safe altitude (below treeline if practical) until the situation can be deconflicted via radio communication or landing in accordance with 2.3.1.

e. The operational time above 400 feet AGL shall be limited to the time required to achieve the objective.

f. If a prolonged flight(s) is/are required above 400 feet, a NOTAM or 5.1 NOTAM shall be requested, and a second visual observer shall be added to the crew to optimize situational and airspace awareness.

g. In controlled airspace the pilot will contact the controlling agency responsible for the airspace and remain below 400 feet AGL unless a higher altitude is authorized by the controlling agency.

h. With authorization, the pilot may operate at an altitude greater than 400 feet AGL, provided that the pilot complies with all operating procedures.

i. Where a requirement for BVLOS exists, the pilot will follow the established procedures for BVLOS flight.

2.3.19 Operations within 3 NM of a Military Authority’s Aerodrome

InDro SOPs for operations within 3 NM of a military authority’s aerodrome are as follows:

a. Operations within 3 NM (5.6 km) of an aerodrome operated under the military’s authority are possible when performed per proved operations by the CAA.

b. Pilots must receive authorization from the Base/Range Control Officer and/or the Base Wing Commander and/or military Air Traffic Service Provider responsible for the area of operations.

c. Pilots must also adhere to any additional requirements, restrictions, or limitations imposed by the aforementioned entities. For example, Canadian DND, Class F airspace (CYR/CYD)

d. Operations in any class of military-controlled airspace will only be conducted with the permission of the applicable operating authority. CAA’s approved procedures that permit operations within any military airspace will be contingent on the military-controlled airspace approval.

2.3.20 Non-Unauthorized Operations in Civilian Controlled Domestic Airspace

For First Responders, VLOS flights in civilian controlled domestic airspace may proceed without gaining authorization from the provider of air traffic services under the following conditions:

a. The operation must be for the purposes of preventing immediate risk to human life, or a major incident which is beyond the scope of business-as-usual operations, and is likely to involve serious harm, damage, disruption or risk to human life or welfare, essential services, the environment, critical infrastructure or national security.

b. The pilot will operate the drone at 400 ft AGL or lower.

c. A visual observer must be used.

d. The pilot must always maintain immediate contact with their crew members.

e. The pilot must make all reasonable efforts to contact the local ATC unit and advise them of the operation including the location of the operation and the pilot's contact details.

f. The pilot will make frequent broadcast awareness calls if the security of the scenario allows for it

g. The pilot must be contactable by the ATC unit at all times during the operation via the contact details provided.

h. The pilot shall inform ATC at the end of the operation.

3 AIRCRAFT FLOWS AND CHECKLISTS

3.1 GENERAL

Within the piloting community the use of checklists has evolved from the straightforward challenge and respond (or tell/do/reply) checklist to more natural techniques. These involve flows, which are the set-up of the cockpit subsystems in a natural, often pilot created series of steps. In most cases these follow cockpits landmarks for selection of the succession of actions, or page sequence in a Flight Management System. A flow may be followed by the conduct of a checklist wherein the crew checks (crosscheck and verify) that the most important selections have been made correctly. This part has been prepared using procedure flows, and checklists for the most important actions. It contains all the flows and checklists that are used by InDro Robotics during RPAS flight operations, after a mission planning session. For advanced procedures these include:

a. Pack Up Flow;
b. Pre-Flight Crew Briefing Flow;
c. Site Setup Flow;
d. RPA Setup Flow;
e. Power On Flow;
f. Pre-Flight / Run-up Flow;
g. Pre-Take-Off Checklist;
h. Take-Off Flow;
i. In-Flight Flow and Guidance;
j. Pre-Landing Checklist;
k. Landing and Shutdown Flow;
l. Pack Up;
m. Debrief Flow; and
n. Battery Charging Flow.

For abnormal and emergency procedures, flows and checks include:

a. Cold Weather SOPs;
b. Emergency Landing / Recovery;
c. Flight Termination;
d. Communications Failures;
e. Command and Control Link Failure; and
f. Loss of Visual Contact.

3.2 ADVANCED OPERATIONS

Advanced operations allow offsite pilot operations by implementing flows and checklists that enhance communication and safety procedures between PIC and VO. Thus, highlining communication protocols stipulating limitations by CAA's approved operations within the approved operational envelop or allowing live camera feeds to enhance pilot awareness if the remote pilot considers it necessary during the following flows. The remote pilot has complete control and authority over the operations.

In the case of advanced operations requiring an offsite PIC, and under FAA 14 CFR Part §§ 107.31 and 107.33 waiver, the following applies:

1. The visual observer will monitor the airspace for any approaching aircraft and notify the remote pilot in command to suspend operations. The flight will be suspended until

the airspace has been cleared by other aircraft.
2. The pilot will ensure that the sUAS operates at an altitude exceeding 115 feet above ground level during daylight hours in Class G airspace.
3. All flight personnel will complete a risk assessment for each flight outlining the risk of the flight and a detailed plan to mitigate the risk.
4. All sUAS will be equipped with a return home function in malfunction and geofencing.
5. The flight crew will complete a pre-flight checklist before all flights. The pre-flight checklist will include the inspection of all equipment used for the flight and require testing of all functions of the sUAS.
6. All flights paths will be in the pre-determined flight zones. The pilot will define the zones and establish geo-fencing limits. The VO will visually inspect all flight zones before the flight to ensure that the area is clear of personnel. Also, the VO has identified any obstacles before and during the flight. In addition, the VO will confirm with the remote pilot location of barriers and that no personnel is in the area of operation

3.2.1 Pack Up Flow

(1) Ground control station and flight software

- check for current version, and
- error messages.

(2) Hand controller – fully charged, as required.

(3) Back Up hand controller – fully charged and linked to RPA, as required

(4) BVLOS Cellular connectivity components (BVLOS only)

(5) Camera Memory Cards empty and ready to be formatted.

(6) Secure InDro RPAS in case.

(7) Spare rotors.

(8) Sufficient LiPo batteries – charged and software updates incorporated.

(9) Battery warmer equipment (if available and required).

(10) Canopy, table and chairs (if required).

(11) Fire extinguisher(s).

(12) First aid kit.

(13) Anemometer.

(14) Spectrum analyser with charged battery.

(15) Toolbox (complete for mission).

(16) Portable power pack (if required) - charged.

(17) Extension cord and power bar (if required)

(18) 12 VDC to 110 VAC inverter (if required).

(19) LiPo battery charger with LiPo charging bag.

(20) Inter-crew comms radios (tested and charged).

(21) Aviation radio(s) (tested and charged).

(22) Cell Phone(s) or Satellite Phone (charged).

(23) 8 x red or yellow cones.

(24) Landing pad (if required).

(25) Critical mission documentation depending on the location and corresponding CAA oversight the following documentation may be needed:

- FAA waivers and exemptions* (For operations approved in the US),
- TCCA SFOC * (For operations approved in Canada),
- TCCA SFOC Application *(For operations approved in Canada),
- SOPs* (applicable for any CAA with corresponding CAA approval),
- Canada Flight Supplement and maps *(For operations approved in Canada operating environment),
- FAA Flight Supplements, AIMs, and maps,
- Checklists and Placards,
- Company Operations Manual *,
- RPAS Flight Manual *,
- Emergency Contingency Plan,
- Notices to Airmen (NOTAMS) *,
- ATC authority (NavCan airspace approval or FAA ATO approval if needed),
- InDro operational clearance*, and proof of insurance (policy number) *.

* Could be stored and accessed electronically.

3.2.2 Pre-Flight Crew Briefing Flow

(1) Mission identification.

(2) Location.

(3) Crew and respective responsibilities.

(4) Time of mission and departure time.

(5) Weather.

(6) Mission description.

(7) Equipment identification.

(8) Radio frequencies and procedures for normal and emergency operations

(9) Review of Emergency Procedures including location and use of emergency equipment.

3.2.3 Site Setup Flow

(1) Conduct inspection of immediate area for physical obstacles.
Note: all zones are visually inspected before and during operations to ensure no people or other aircraft are present in the area and that any obstacles have been identified.

(2) Verify notification of nearby property owners of your mission intentions (permission if necessary).

(3) Mission plans and flight plans should be shared with other RPAS operators in the vicinity who will be operating at the same time.

(4) Ensure that the weather conditions are suitable for the operation (also consider airspace and VMC requirements).

(5) Check wind direction and speed and verify they are within RPAS limits.

(6) Assess possible wind complications.

(7) Ensure no icing conditions are exist or are forecast to exist at flight time and altitudes. (use actual vs. forecasted temperature and dewpoint, if available)

(8) Check radio frequency energy in the operating vicinity, if equipped.

(9) Locate suitable take-off and landing area.

(10) Lay out cones (and take-off pad if applicable).

(11) Locate mission control area.

(12) Identify potential alternate landing sites in case take-off site is obstructed.

(13) Review all actions and contingencies for the mission planned.

(14) Review contingency planning, which would include safe routes in the event of a system failure, degraded performance or lost communication link.

(15) Discuss flight plan with your Visual Observer.

(16) Confirm crew communication devices operational.

(17) Secure the area.

(18) Position table and chairs (if required).

(19) Turn on aviation radio and set appropriate frequency to monitor/broadcast.

(20) Position fire extinguisher(s) and first aid kit in an easily accessible location.

3.2.4 RPAS Setup Flow

(1) Unpack RPA and ground station components, inspect for any visible damage.

(2) Confirm charge level of available batteries.

(3) Set up ground station (controller with tablet or other computer device).

(4) Set up and position antennas with broad side toward flight area.

(5) Ensure correct flight mode is selected.

(6) Remove propellor and gimbal locks on RPA.

(7) Inspect / clean sensor lens and ensure payload is secured and connectors are firmly attached.

(8) Place RPA on a flat level surface.

(9) Inspect rotors for damage, specific focus on leading edge.

(10) Secure rotors to appropriate motors.

(11) Have VO confirm propellers installed correctly by gently confirming full lock, lifting up on propellers and audibly confirming “propeller secure”.

(12) Insert RPA battery, ensure sufficient energy for the planned flight.

3.2.5 Power On Flow

(1) Ensure no obstructions for 360 degree motion of camera gimbal.

(2) Power ground station

(3) Ensure there are no personnel within 10 ft of RPA except for PIC and VO.

(4) Call “POWER ON”, power on RPA.

(5) Confirm connection between RPA and ground station.

(6) Confirm video connection to RPA and video feed successful.

(7) Confirm tactical map available if required.

(8) Confirm ‘lost link’ and cellular fail settings on RPAS and ensure appropriate for area /mission / contingency volume limits.

(9) Cross check and verify flight setting are correct: RTL, ceiling limits and distance fences,beginner mode settings, etc.

(10) Verify pre-planned waypoints (flight routes) have been entered and cross checked.

(11) Verify camera settings are correct (still images, video, aspect ratio, frame-

rate, etc.).

(12) Confirm video latency is satisfactory.

(13) Confirm HD video channel and signal strength.

(14) Confirm battery level is sufficient for the mission.

(15) Confirm cellular signal is at least 50% of max (BVLOS only)

(16) Confirm SD card is installed, formatted, and available (if recording required for mission).

(17) Switch between flight modes and confirm correct reports from RPA.

(18) If flying in a new geographic area, perform compass calibration.

(19) Wait for the RPA to obtain a GPS lock and/to update mission planning software with the current location.

(20) Verify sufficient GPS satellite count if more required beyond a GPS lock.

(21) Confirm ground station status indicates ready for flight and no other system warnings.

(22) Follow RPAS manufacturer-based checklists for launch.

3.2.6 Pre-Flight / Run-Up Flow

(1) The RPA should be launched by two people; one initiating the launch and the other acting as an observer or Operations Manager.

(2) Determine the wind speed and direction and verify they are within limits.

(3) Ensure no icing conditions are present or expected at flight altitudes.

(4) Verify RPA is in a flat level location safe for take-off.

(5) Check video, cellular (BVLOS) and RC transmitter / receiver signal strength.

(6) Confirm flight mode.

(7) Check altitude readout.

(8) Check speed readout.

(9) Check home location.

(10) Check RTL transit height.

(11) Scan for nearby cars / people / animals.

3.2.7 Pre-Take-Off Checklist

PRE-TAKE-OFF CHECKLIST

Observer	Pilot
Wind and Weather	Within Limits*
Air Vehicle Batteries	Charged, sufficient
Hand Controller	ON and Charged, sufficient
Ground Station	ON and Charged, sufficient
Cameras	ON / Not Required
Take-Off Mode	Set
Area and Air Traffic	Clear
BVLOS Flight Radio call	Completed
Cleared Take-Off	"CLEAR"

* for BVLOS operations, remote VO must provide values for pilot confirmation

3.2.8 Take-Off Flow (Free Flight)

(1) Start RPA (using standard procedures) to a ready-to-launch state,

(2) Increase throttle slightly listening for any abnormalities.

(3) Short 10 second hover at 8 to 10 feet (listen for vibrations / loose items).

(4) Confirm voltage levels are correct.

(5) The pilot can then begin flight mission by departing into wind or other suitable direction.

3.2.9 In-Flight Flow and Guidance

(1) If flying manually, always keep your fingers on the controller.

(2) For VLOS operations, maintain visual contact with the RPA.

(3) Climb to a safe altitude away from potential hazards and to reduce noise signature.

(4) Keep aircraft at a safe operating distance from people, electric utility lines and buildings.

(5) Employ your Visual Observer.

(6) Do not fly RPAs within distance defined by local laws (and the SFOC) of any private / commercial airport / helipad.

(7) Do not fly around a pre-existing RPAS flying site without a frequency-management agreement.

(8) For BVLOS operations, conduct broadcast radio calls at 5 minute intervals

(9) Announce in-flight transitions between BVLOS and VLOS and vice versa

(10) For landing scan landing area for potential obstructions and hazards.

(11) Check wind direction and speed.

PRE-LANDING CHECKLIST

Observer	**Pilot**
Wind	From <Direction>
Battery	Above 20%
Air Traffic	Clear
Landing Area	Clear
Mode	…..Selected as required
Cleared Landing	"PREPARING TO LAND"

3.2.10 Landing and Shut Down Flow

(1) After checking that the landing area and circuit is clear, the autopilot can be switched to the preferred flight mode for landing.

(2) Approach into wind.

(3) Carefully land the aircraft away from obstructions and people.

(4) After landing hold throttle down for three seconds to disarm the RPA.

(5) Ensure propellers are fully powered down.

(6) Disarm ground control station, as required.

(7) Ensure no personnel are within 10 ft of RPA.

(8) Pilot removes hands from the hand controller (left hand to side).

(9) VO (if available) approaches, powers down RPA, calls "POWER OFF"

(10) IF BATTERY SWAP – Insert battery with sufficient power and initiate step 5 of Power-On flow.

(11) IF SHUT DOWN – Continue below.

(12) Power down ground control station.

(13) Power down controller.

(14) Power down other flight devices (tablet/telephone).

(15) Broadcast radio call upon mission completion or direct to ATS, as required

3.2.11 Pack Up Flow

(1) Reset controller and camera settings to InDro or client default settings.

(2) Ensure batteries are secure and safe.

(3) Remove propellers from RPA, inspect for damage and secure.

(4) Remove camera and stow.

(5) Inspect for damage and place RPA carefully into case.

(6) Detach tablet with cable and secure/stow.

(7) Secure controller into case.

(8) Separate charged and discharged batteries.

(9) Stow all other tablets and all other equipment.

3.2.12 Debrief Flow

(1) Complete calculations for batteries and flight times.

(2) Fill out maintenance, flight and personal logs.

(3) Download and back-up images off memory card(s).

(4) Return memory card to RPA.

(5) Put away gear, air vehicle and logbooks.

(6) Conduct flight debriefing to review procedures, safety points and lessons learned.

3.2.13 Battery Charging Flow

In the absence of manufacturer guidance for charging (ex. Alta X) this general procedure may be followed. Typically charging procedures are found in the user manual.

(1) Plug charger hub into the wall socket.

(2) Place batteries onto the hub.

(3) Set the charger to charge.

(4) Ensure Light Emitting Diodes (LEDs) indicate charging.

(5) Wait for charge cycle to complete.

(6) Use manufacturers procedures and log to monitor battery health (if necessary).

3.3 ABNORMAL AND EMERGENCY PROCEDURES FOR ADVANCED OPERATIONS

3.3.1 Cold Weather RPAS SOPs

In general, the RPAS crew should make sure batteries are fully charged before each flight. Follow manufacturer guidance for cold weather operations. If none such exists, the following practices should be followed. If possible, warm batteries to 25°C or before flight. Use of a battery heater is recommended.The pilot should hover the aircraft for approximately one minute to allow the battery to warm up prior to commencing with a mission. The pilot should turn on “Show Voltage on Main Screen on the Aircraft Battery page of the Go app and discontinue flying if battery cell voltage drops below 3.2v, or equivalent for other manufacturers.

(1) Ensure RPAS is completely dry prior to setup.

(2) Allow RPA to acclimatize to external temperature for 10 min.

(3) Ensure batteries are fully charged.

(4) Monitor battery levels and land ASAP if voltage drops below 3.2 v or is below 40%.

(5) Warm batteries to 25°C using battery heater and follow heater manufacturer guidance procedures.

(6) Avoid heavy control inputs that demand significant power draw during flight.

3.3.2 Emergency Landing / Recovery

In the event that the PIC must conduct an immediate or ASAP emergency landing or recovery, the PIC will:

(1) Notify the crew that an immediate or ASAP emergency landing is required.

(2) Identify a suitable landing site or ditching location.

(3) Assess controllability of the RPA.

(4) Verify that the landing site is clear of persons and buildings.

(5) Manoeuvre the RPA to a hover over the selected landing site.

(6) Visually or using the on-screen display, stop all lateral drift.

(7) Note GPS location.

(8) Descent vertically by reducing the throttle.

(9) Following touchdown set throttle to zero.

(10) Locate RPA.

(11) Disconnect batteries.

3.3.3 Flight Termination

If the RPA in flight is a hazard to other airspace users, or persons or property on the ground the PIC willterminate the flight using the following steps so long as the flight termination does not increase the danger.

(1) Attempt to manoeuvre the RPA to an area clear of persons and buildings.

(2) Notify the crew that the flight will be terminated.

(3) If possible, reduce airspeed to zero.

(4) If possible, reduce height Above Ground Level (AGL) to a low hover.

(5) Force motor shutdown using CSC or other method.

(6) Bring fire extinguisher and first aid kit to the location of the downed RPA.

3.3.4 Communications Failures

In the event of a communication failure (e.g., ATC, visual observer, etc.) of any kind, the PIC will:

(1) Interrupt the planned mission and direct the RPA to a landing as soon as practical.

(2) Advise crewmembers of the communication failure using plain voice, if possible.

(3) Reduce altitude to the lowest safe height AGL.

(4) Fly directly to a suitable landing area.

(5) Land, locate and shutdown the RPA.

(6) Begin investigation as to the cause and resolution of the communication loss

3.3.5 Command and Control Link Failure

In the event of a command and control link failure, the PIC will:

(1) Observe the behaviour of the RPA.

(2) Notify the crew of the command and control link failure using the inter-crew handheld radio.

(3) Verify that the home location is clear of personnel.

(4) Power cycle the ground station, if recommended by manufacturer.

(5) Monitor automatic return flight.

3.3.6 Loss of Visual Contact

In the event of loss of visual contact with the RPA (sun, cloud, obstacles, etc.) the PIC will:

(1) Switch to P-GPS (or equivalent) mode, announce the mode change and initiate a hover.

(2) Advise the Visual Observer that visual contact with the RPA has been lost.

(3) Attempt to regain visual contact using visual search best practices.

(4) Check instrumentation to determine altitude, speed, and location.

(5) Initiate RTL function.

(6) Continue visual search until RPA is located.

3.4 ENHANCED FLIGHT MANOEUVRES

3.4.1 General

In order to safely conduct the more advanced flight manoeuvres, InDro has developed an internal training program that is comprehensive. Internally it is referred to as the InDro Enhanced Flight Training Program. Topics included in the enhanced program are:

a. Introduction to Enhanced Flight Manoeuvre training;
b. BVLOS flight;
c. Flight over 400 feet;
d. Flight operations at advertised events;
e. Flight within 3 NM of DND aerodromes;
f. RPAS maintenance;
g. Conduct of a site survey for Enhanced flight activities;
h. Enhanced program emergency procedures;
i. Determination of minimum weather requirements;
j. Collision avoidance and maintenance of separation with other aircraft;
k. Coordination of Enhanced manoeuvres with ATC;
l. Terrorist HAZMAT RPAS Procedure; and
m. Social Disturbance RPAS Procedure.

3.4.2 Flight Beyond Visual Line of Sight

Flight BVLOS is detailed in Subsection 3.5

3.4.3 Flight Over 400 feet AGL

(1) Assess airspace structure and limitations above the standard 400 ft limit.

(2) Match operational requirements with airspace limitations to determine maximum height required.

(3) Request flight clearance if flight profile extends above Class G airspace.

(4) Modify visual scan techniques and discuss with VO.

(5) Employ binoculars if lighting conditions are appropriate.

(6) Activate aviation anti-collision beacon if appropriate.

(7) Incorporate time to descend in “return to launch” battery check.

(8) Adopt “flight at altitude” skill set.

3.4.4 Flight Operations During Advertised Events

(1) Assess airspace structure and limitations for NOTAM issuance at advertised event.

(2) Advise the media regarding the use of a RPAS at the event.

(3) Coordinate flight operations with the event organizer.

(4) Request flight clearance if flight profile is outside Class G airspace.

(5) Plan flight route to avoid overflight of people unless the RPA is properly equipped.

(6) Modify visual scan techniques to include threats from the crowd.

(7) Adopt “flight at advertised event” skill set.

(8) Incorporate additional security at take-off and landing locations.

3.4.5 Flight Within 3 NM of a Military Aerodrome

(1) Ensure SFOC for DND flight is current and valid.

(2) Conduct map study to identify extent of military base.

(3) Conduct Canada Flight Supplement review to determine military flight routes to and from the base.

(4) Gain normal ATC flight clearance if required.

(5) Gain Base Operations flight and surface clearance as required.

(6) Maintain communications on required modality (telephone, radio, etc.)

3.4.6 RPAS Maintenance

(1) Follow the maintenance procedures contained in the manufacturer’s maintenance manual.

(2) Conduct a review of past maintenance conducted as documented in the RPAS Journey Log.

3.4.7 Enhanced Program Site Survey

(1) Carry out a standard Site Survey in accordance with CARs Part IX Section 901.27 (repeated here for convenience):

(2) Identify en route flight hazards such as towers, wires, masts, buildings, cell phone towers and wind turbines.

(3) Identify potential RF energy sources.

(4) Identify possible VO deployment locations.

(5) Identify and highlight alternative landing site(s).

(6) Identify and highlight the proximity of aerodromes, airports and heliports.

(7) Incorporate navigation route planning.

(8) Highlight airspace changes en route.

(9) Incorporate Navigation Pilot Log Card as required.

Site Survey

901.27 No pilot shall operate a remotely piloted aircraft system unless, before commencing operations, they determine that the site for take-off, launch, landing or recovery is suitable for the proposed operation by conducting a site survey that takes into account the following factors:

(a) the boundaries of the area of operation;

(b) the type of airspace and the applicable regulatory requirements;

(c) the altitudes and routes to be used on the approach to and departure from the area of operation;

(d) the proximity of manned aircraft operations;

(e) the proximity of aerodromes, airports and heliports;

(f) the location and height of obstacles, including wires, masts, buildings, cell phone towers and wind turbines;

(g) the predominant weather and environmental conditions for the area of operation; and

(h) the horizontal distances from persons not involved in the operation.

FAA 14 CFR Part 107 § 107.49 Preflight familiarization, inspection, and actions for aircraft operation.

(1) Prior to flight, the remote pilot in command must:

(2) Assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. This assessment must include:
- Local weather conditions;
- Local airspace and any flight restrictions;
- The location of persons and property on the surface; and
- Other ground hazards.

(3) Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards;

(4) Ensure that all control links between ground control station and the small unmanned aircraft are working properly;

(5) If the small unmanned aircraft is powered, ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time;

(6) Ensure that any object attached or carried by the small unmanned aircraft is

secure and does not adversely affect the flight characteristics or controllability of the aircraft; and

(7) If the operation will be conducted over human beings under subpart D of this part, ensure that the aircraft meets the requirements of § 107.110, § 107.120(a), § 107.130(a), or § 107.140, as applicable.

3.4.8 Enhanced Program Emergency Procedures

Emergency procedures are addressed in Subsections 2.3 and 3.3. Specific procedures that relate to Enhanced Operations will be included in this subsection. At this time, this subsection contains the following emergency procedure(s):

a. **Diversion during cross-country flight.** In the event that the pilot must divert the RPA while en route, they will:

(1) Advise the flight crew of the need to divert and intentions.

(2) Determine current location on the moving map.

(3) Determine the track required to fly to the diversion point.

(4) Determine the en route altitude or height necessary for the diversion.

(5) Turn to the required track and manually fly to the diversion point or program the RPAS to fly point or point to the diversion location.

(6) Toggle, or switch attention between the moving map and the pilot cam to conduct match-map-ground navigation techniques.

b. **Pilot monitor failure during BVLOS operations.** In the event of a loss of a hand controller display (monitor) the pilot shall:

(1) Advise the flight crew of the system failure (blank screen).

(2) Establish a hover.

(3) Conduct a self-generated rapid diagnostic check of the display system.

(4) Replace display if possible.

(5) Activate RTL function.

(6) Identify relative bearing of RPA.

(7) Regain manual control when RPA is within sight.

(8) Land as soon as practicable remaining clear of people.

3.4.9 Enhanced Program Determination of Minimum Weather Requirements

During aircraft operations the pilot must plan a mission, determine the minimum weather requirements for the conduct of the mission, and on the day of the flight verify that the existing weather conditions are suitable of the planned mission. For advanced operations, CARs Part IX and FAA 14 CFS part 107 sec. 107.49 provides regulatory weather requirements:

> Minimum Weather Conditions
>
> **901.34** No pilot shall operate a remotely piloted aircraft system unless the weather conditions at the time of flight permit
>
> **(a)** the operation to be conducted in accordance with the manufacturer's instructions; and
>
> **(b)** the pilot of the system and any visual observer to conduct the entire flight within visual line-of-sight.

§ 107.49 Pre-flight familiarization, inspection, and actions for aircraft operation.

(1) Prior to flight, the remote pilot in command must:
   (a) Assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. This assessment must include:
      a. Local weather conditions;

§ 107.51 Operating limitations for small unmanned aircraft.

A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with all of the following operating limitations when operating a small unmanned aircraft system:

(1) The ground speed of the small unmanned aircraft may not exceed 87 knots (100 miles per hour).
(2) The altitude of the small unmanned aircraft cannot be higher than 400 feet above ground level, unless the small unmanned aircraft:
   1. Is flown within a 400-foot radius of a structure; and
   2. Does not fly higher than 400 feet above the structure's immediate uppermost limit.
(3) The minimum flight visibility, as observed from the location of the control station must be no less than 3 statute miles. For purposes of this section, flight visibility means the average slant distance from the control station at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.
(4) The minimum distance of the small unmanned aircraft from clouds must be no less than:
   1. 500 feet below the cloud; and
   2. 2,000 feet horizontally from the cloud.

Weather will be assessed in the pre-flight processes and again on site using available technology.

For Enhanced Flight Operations (BVLOS) the supplemental minimum weather conditions for continued flight are as follows:

(1) If the RPA is not visible (BVLOS) the pilot shall (using the pilot cam or the payload camera) remain clear of cloud; the minimum weather conditions require the ceiling to be 1000' AGL and the visibility 3SM at all

observable locations along the route to be flown.

(2) In addition, it is InDro's policy that the RPA shall not be used for BVLOS operations unless the forecast weather is equal to or better than the following:

a) forecast visibility in the BVLOS area shall not be less than 3 miles;

b) distance from cloud shall not be less than 500 feet vertically and 1 mile horizontally; and

c) no forecast for or presence of icing conditions.

(3) Monitor available onboard RPAS sensor systems to ensure that weather limits (icing, wind, turbulence, rain, temperature) are adhered to.

(4) Ensure sun position (angle/location) will not cause hinderance to the VO's ability to maintain line-of-sight within the flight volume.

3.4.10 Collision Avoidance and Maintenance of Separation with other Aircraft

In order to avoid collision with another aircraft the RPAS pilot shall:

(1) Conduct blind broadcast radio calls prior to take-off and when landing

(2) During BVLOS operations, fly at a low height AGL consistent with safe terrain and obstacle clearance, and adequate C&C connections.

(3) During BVLOS operations, deploy the VO, within reason, to observe the departing and arriving RPA and to enhance airspace awareness.

(4) The VO(s) will employ binoculars, as required, to maintain airspace awareness of 2 NM in any direction. Maximum end-to-end airspace coverage for human DAA is 4 NM.

(5) For BVLOS operations, the use of high intensity flashing anti-collision lighting is required for human DAA and recommended for all flights. The lighting must be:
- White in colour
- Visible through NVGs for night operations only
- Flashes at a rate of not less than 40 or more than 100 cycles per minute
- Has an intensity sufficient to be visible at a minimum distance of 1 NM (can be tested operationally to confirm)

(6) Optimise radio reception from the operating area and maintain a radio watch with special awareness of local VFR Check Points.

(7) Conduct blind broadcast radio calls at 5 minute intervals using the following format:
- Traffic in the vicinity of [area identifiable using VFR chart] this is a remotely piloted aircraft operating [maximum altitude] and below [distance, direction from a of point of interest on VFR chart] for the next [time frame of flight]

3.4.11 Coordination of Enhanced Manoeuvres with ATC

If enhanced manoeuvres are to be conducted in controlled airspace, normal procedures will be used to obtain flight clearance. The pilot shall ensure that the mode of communication is identified, and a suitable back-up is available. Coordination of Enhanced Manoeuvres with ATC shall be detailed in the ATC response to the RPAS Flight Authorization Request.

3.4.12 Terrorist HAZMAT RPAS Procedure

The Terrorist HAZMAT RPAS Procedure is detailed in Subsection 3.6.1 of the document.

3.4.13 Social Disturbance RPAS Procedure

The Social Disturbance RPAS Procedure is detailed in Subsection 3.6.2 of the document.

3.5 NORMAL AND ABNORMAL BEYOND VISUAL LINE OF SIGHT PROCEDURES

3.5.1 General

The procedures used for BVLOS flight have been prepared to allow safe flight without the pilot or VO specifically viewing the air vehicle. General comments/procedures are as follows:

a. **Emergency Security Perimeter.** For work with First Responders, the Pilot in Command or designate will collaborate with Incident or Site Command and all other participating agencies related to an operation to establish, monitor and designate an “Emergency SecurityPerimeter” directly related to the operations. Including notifying ATC of NOTAMS or requesting airspace restrictions. Restrictions imposed by Site Command at therequest of the Pilot in Charge or designate will promote optimal site and operatingarea safety. Restrictions may include movements of persons, bystanders, vehicles, aircraft, RPAS, and travel within the operating area as required based upon the operational needs of the environment and operation.

   The Pilot in Command or designate will coordinate all RPAS activities under the principles of a Unified Command approach to protect public and responder safety. The Pilot in Command or designate will always ensure open communications with the Incident or Site Command to ensure a coordinated inter-agency response that includes RPAS VLOS and / or BVLOS operations.

b. **Flight Planning.** Flight within VLOS involves a map study (as part of the site survey) and visual awareness of the RPA’s location with respect to terrain or obstacles. The distances involved with flight BVLOS may require an expanded site survey that includes flight planning. This is required in order to maintain situational awareness, both of the relative bearing to the RPA but also amp hours remaining in relation to the distance to be flown and wind encountered. Flight planning will involve defining the flight geography, contingency volume and emergency boundaries as well as the air risk buffers (as applicable) for the particular operation.

c. **Mission Applicability.** The BVLOS procedures itemized below are intended for use by First Responders including the hospitals, medical staff, RCMP, Provincial Police, Paramedics, Fire-Rescue, and Search and Rescue. They are prepared for actual operational missions, training for such missions and demonstrations of such missions.

d. **Flight at Altitude.** When BVLOS operations up to 700 ft are required, normal SOPs will be applied for flight above 400 feet AGL, that is to say, there are no specialized SOPs for BVLOS operations between 400 feet AGL and 700 feet AGL. Flight above 400 ft is only expected in exigent circumstances.

e. **Flight over People.** The general procedures used for flight over people will be adhered to during flight BVLOS. As with flight within VLOS, an Advanced Pilot is required, an Advanced RPA is required, and TC approved procedures are required.

f. **Night Flying.** Normal procedures (InDro taught night flying techniques) will be adhered to during BVLOS flight at night. In addition, BVLOS SOPs applicable for day operations shall be followed during night operations (e.g.: BVLOS Cross Country Flight Planning, Preventing Controlled Flight Into Terrain, etc.). The RPA must be equipped with proper lighting.

Specifically, during night flight, the RPAS flight crew will adopt the following techniques:

(1) Conduct the night pre-flight inspection during the day or indoors whenever possible.

(2) At night, take extra time for even the easiest of tasks, because everything about flying at night requires more time and attention.

(3) Maintain night adaptation of the flight crew’s eyes.

(4) Carry a flashlight and a backup flashlight - consider wearing a headlamp to keep your hands free.

(5) Ideally use red light; it'll help your eyes adjust to the darkness and give you the best vision.

(6) Night means the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time. As a rule of thumb use 30 minutes after sunset to 30 minutes before sunrise.

(7) Plan your day’s events to accommodate night flying; if it's late at night andyou're tired, you may not be fit for duty.

(8) An additional 5% power reserve will be added for night cross-country flights.

(9) Verify that the rate of power consumption, used for flight planning, includes power consumption required to illuminate all lights.

(10) Maximum surface wind for night operations: 15 kts.

(11) Review lighting sequences during pre-flight briefing.

(12) Maintain a Minimum Equipment List (MEL) specifically for flight at night.

(13) Stay clear of RPA when it is powered up as black spinning blades cannot be seen at night.

(14) Fly with an anti-collision light selected to ON as per AC 903 and 3.4.10 (4)

(15) Fly with navigation lights selected to ON.

(16) Use strobes when about to take-off and deselect after landing.

(17) During night BVLOS flight, remain vigilant for low clouds.

(18) Emergencies will not be simulated during flight at night.

(19) Keep the panel/switch lights dim as you fly at night. The lower the light from hand controller screen and switches and the mission computer, the easier it is to see RPA lights.

(20) At night, peripheral vision detects motion the best. When scanning for traffic, spend a few seconds looking at each section of your field of view, paying attention to your peripheral vision to detect other aircraft. If you see another plane, don't try to focus directly on it. Instead, look slightly to the side of the traffic. Your eyes will pick up more motion information by viewing it offset.

(21) Clouds and terrain will block lights ahead of you, so pay extra attention to minimum safe altitudes and don't forget about the terrain and obstacles around you.

(22) Position VO so their perspective of the flight area is not facing toward the moon or other bright light source

(23) You need to rely on your instruments and landing pad lighting much more during night landings. Consider setting out a “T” of lights on the landing pad and cross-check the pilot cam image on final approach to the “T”.

(24) Be aware of the black hole effect; pilots tend to fly lower approaches if there are no lights around the landing location, hence the term "black hole". The darkness sucks you in, and if you aren't careful, it can cause you to crash short of the landing pad.

(25) Landing in rain at night is a lot like the black hole effect. If you're landing in rain, you get the illusion that you're higher or lower than you actually are. That means you could fly a lower than normal approach, getting the RPA dangerously close to the ground or higher than normal making the glide slope awkward and unsafe.

g. **VO Incapacitation.** The VO in a BVLOS mission, whether remote or co-located is a critical role in maintaining safety. If the VO becomes incapacitated and cannot immediately transfer control to another VO, the flight will be terminated as soon as practical. As the VO provides DAA, the aircraft must minimize the time in airspace while landing safely.

h. **Pilot Incapacitation.** All site flight crew members are trained to activate flight termination procedures in the event of impending or actual pilot incapacitation.

This will be included in the pre-flight briefing for BVLOS missions to ensure the switch or trigger is familiar to all.

3.5.2 BVLOS Cross Country Flight Planning

In preparation for BVLOS flight, day or at night, the pilot will use basic pre-flight navigation planning techniques, including:

Map study and map preparation. Map study will be undertaken with both a current VNC or VTA of the area (digital charts such as those contained in ForeFlight are acceptable), and a 1:50,000 map or scaled Google Map print-out of the area. Unlike manned flight, RPAS navigation planning will use desired track and heading as the same value in degrees in that the onboard flight controller establishes steady heading sideslips to compensate for wind. If the pilot is concerned about violating height limitations, waypoints will be set as points wherein the pilot will adjust Height Above Launch in order to maintain a constant height AGL along the route. To ensure contingency volume limits are respected on missions with large terrain gradients, a degree of terrain following is achieved through the placement of waypoint guidance. Pre-flight, the pilot will follow the “ticker tape” indicating terrain along flight path. When differences are noted that would cause the aircraft to 1) encroach unsafely on terrain or 2) encroach unsafely on airspace above, the pilot will enter waypoints before and after the terrain change. The vertical position between these way points ensures the RPA will adjust altitude within the prescribed limits and does so safely without the need to emulate a glideslope between the two points. The aircraft will climb to or maintain the higher altitude of flight while over the lower terrain waypoint, so long as altitude restrictions are respected. Distances will be measured in nautical miles (preferred) or kilometers. There is no requirement to calculate magnetic values because all tracks and heading will be conducted in true values.

(1) **Preparation of a Flight Planning Form.** For cross county flights and round robins, a flight planning form will be completed. The pilot may use a form of their choosing, but it must contain the information shown in Figure 3-1. Battery remaining will be used instead of fuel, and the reserve on landing will be planned to be not less than 20%.

(2) **Completion of a Pilot Navigation Log Card.** Relevant information calculated on the flight planning form will be transferred to a Pilot Navigation Log Card which will be used throughout the cross-country flight. As noted above the track and heading values will be the same for RPAS flight. Additionally, the ground speed will be maintained by the RPAS flight controller and set to a value preferred by the pilot. The log card used is up to the discretion of the pilot but must be similar to Figure 3-2.

3.5.3 Transition from VLOS to BVLOS Flight at Medium Altitude

The following procedure may be conducted during the day or during flight at night when the RPAS is operating at altitudes at or near the height of ground obstructions. These altitudes are deemed to be “medium” whereas “high altitude” is a relative term indicating in airspace clear of terrain and ground obstructions and low is defined in 3.5.5.

(1) Observation by the VO that the RPAS is about to enter a BVLOS situation.

(2) The VO will be responsible for remaining aware of the bearing to the RPAS and scanning of the surrounding airspace for manned aircraft. Either the pilot or the VO will monitor ADS-B for aircraft in the operating area.

(3) The VO will verbally inform the pilot that the RPAS is about to enter BVLOS conditions

(4) Pilot will acknowledge that the RPAS is entering BVLOS and continue advising the VO when the pilot is “eyes in” or “eyes out”.

(5) Pilot will advise of battery status and operational status (normal, camera malfunction) and time remaining in BVLOS.

RPAS NAVIGATION FLIGHT PLANNING FORM

										Kph	
						DISTANCES / SPEEDS are in:				kts	
FROM-TO	HEIGHT (AGL)	TRACK (T)	W / V		VAR	TAS kts	G/S m/sec	DIS-TANCE	TIME (Sec)	BATT (%)	BATT REM

Figure 3-1 Sample Pre-flight Planning Form

RPAS PILOT NAVIGATION LOG CARD

InDro FORM 4256

DATE	PILOT	VO	AIRCRAFT	TIMES						BATT/ MIN
				START UP		TAKE OFF		SET HDG		
Time	FROM	TO	TAS	HEIGHT AGL/ALL	TRACK	G/S	DISTANCE	ETE / ETA	Battery	BATT REM

Figure 3-2 Sample Pilot Navigation Log Card

3.5.4 BVLOS Navigation Procedures

During BVLOS flight, Day or Night, the pilot will use basic in-flight navigation techniques:

(1) **Set heading procedures.**

- A preplanned route will be initiated at a Set Heading Point (SHP), which may be near or directly above the launch location. As the RPA flies over the SHP the pilot will verbalize the local time, note and verbalize that the RPA has turned in the right direction at the right height, note and verbalize the direction of flight is as expected, normally by viewing the ground through the camera, ensure the VO has been advised that the route has been initiated, verify the time to the first programmed turning point has been verbalized and the local time that the destination will be reached has been verbalized.

(2) **Establish pinpoints at checkpoints.**

- En Route to each turning point the pilot will have noted a checkpoint to verify that the RPA is on track. The checkpoints may be a time check, track check or both. The pilot will establish a mental pinpoint as the checkpoint is passed in order to improve situational awareness as the next turning point is approached. If the predetermined checkpoint cannot be found the pilot will continue on track and turn over the turning point to the planned next turning point.

(3) **Adjust heading as required.**

- In the event that, at the checkpoint, the pilot notes that the RPA is off track, the pilot will monitor the situation, adjust heading as required, take over and fly the route manually, or initiate an RTL. The pilot will advise the flight crew of the situation.

(4) **Adjust timings as required.**

- In the event that, at the checkpoint, the pilot notes that the RPA is late when compared to the expected time of arrival at the checkpoint, the pilot will monitor the situation, adjust the groundspeed as required, take over and fly the route manually, or initiate an RTL. The pilot will advise the flight crew of the situation.

(5) T**urn procedures (Time, Turn, Track, Talk, Estimate, Estimate).**

- At each turning point (which may be simply an altitude change) the pilot will verbalize the local time, note and verbalize that the RPA has turned in the right direction at the right height, note and verbalize the direction of flight is as expected normally by viewing the ground through the camera, ensure the VO has been advised that the turning point has been passed, verify the time to the next programmed turning point has been verbalized and the local time that the destination will be reached has been verbalized.

(6) **Watch, map ground techniques.**

- If the flight crew wish to determine the location of the RPA on the map and GPS information is not available to overlay, they will use the watch, map ground technique; that is, they will observethe current time, determine where the pre-flight plan would have them on the map for that time and note features on the map that can be observed from the flight altitude, and then look for these features on theground. All the time the pilot remains aware that what is drawn on the map is on the ground but not all items on the ground are drawn on the map.

(7) **Standard diversion procedures.**

- In the event that the pilot cannot continue the pre-planned route (EMI from a boat, bad weather, etc.) then they will conduct an RTL, re-plan theroute and continue, or continue manually using map-reading techniques. If the pilot considers that sufficient energy is available and the operational volume permits the maneuver, they may consider a 60 deg turn in either direction, flight for 2 minutes, a 120deg turn in the opposite direction, flight for 2 minutes, followed by a turnback to the original heading. Finally, if the terrain is suitable, the pilot may locate a new destination, mentally plan the new route, turn to the required track and conduct a Time, Turn, Track, Talk, Estimate, Estimate check.

3.5.5 Transition from VLOS to BVLOS Flight at Low Altitude

BVLOS flight at low altitude is a day only manoeuvre, therefore this procedure does not apply to flight at night. Low altitudes refer to those where the aircraft is operating (aside from solely take-off and landing) below the height of ground obstructions such as trees and buildings as well as surrounding terrain. During the transition from flight within VLOS to flight BVLOS it is normal that for a short period of time the VO will be required to maintain clearance of the air vehicle from obstacles andterrain. FPV procedures will be used during the normal period of the transition from VLOS toBVLOS.

(1) The VO will advise the pilot that they are about to enter BVLOS at low altitude.

(2) The pilot will ensure that the speed of the RPAS is slow enough to take immediate action to avoid a collision with an obstacle or terrain.

(3) The pilot will ensure (if desirable) that all collision avoidance sensors (including pilot cam) are operating properly.

(4) The pilot will ensure that no objects exist above the RPAS that would create a collision should a lost link failsafe be initiated.

(5) The VO will advise the operator that they have lost sight of the RPAS.

(6) The Pilot will stop transitional movement and scan 360 in order to gain situational awareness.

- Scanning for people and property that may be in the operational area.

- The pilot will advise of battery status and operational status (normal, camera malfunction etc.)

- If a risk of collision exists with people of property, the pilot will either land immediately, or gain altitude, whichever is safer to the people or property.

(7) The VO will continue to scan the airspace.

3.5.6 Transition from BVLOS to VLOS Flight at Medium Altitude

The following procedure may be conducted during the day or during flight at night.

(1) The pilot will advise the VO that the RPAS will reappear from BVLOS flight and provide a bearing to the air vehicle.

(2) The VO will remain “eyes up” until the RPAS is acquired visually. The VO will advise the pilot that the air vehicle can be seen and will advise if it is close enough to be considered within VLOS.

(3) Once the pilot judges the flight condition to be within VLOS the pilot will announce “Within Visual Line of Sight” to the VO and Ground Supervisor (if present).

(4) The pilot will advise of their intentions (continue with mission, return home)

(5) The VO will continue to monitor the surrounding airspace.

(6) The pilot/VO will follow existing VLOS SOPs.

3.5.7 Transition from BVLOS to VLOS Flight at a Low Altitude

BVLOS flight at low altitude is a day only manoeuvre, therefore this procedure does not apply to flight at night.

(1) The Pilot will announce their intention prior to transitioning out of BVLOS at low altitude.

(2) The VO will observe the airspace into which the RPAS will be entering.

(3) Once the VO announces that the airspace is clear the pilot will transition into VLOS from a low altitude BVLOS situation.

(4) Once in the VLOS condition that pilot will advise their intentions and flight platform status.

(5) The pilot/VO will follow existing VLOS SOPs.

3.5.8 Extended Range BVLOS Landing of an RPAS

BVLOS landings are approved by InDro for Day and Night operations.

(1) The Pilot and VO will follow BVLOS procedures outlined above.

(2) Once in the location where the pilot intends to land, the pilot will announce their intention to land and indicate if the area is clear for a safe landing.

(3) A Pre-Landing Check will be conducted.

(4) At all phases of the landing the crew will use the payload(s) to scan the landing area for any incursions. The procedure used is as follows:

- Position the camera(s) to provide a NADIR view as the aircraft descends
- At XXX AGL, position the camera to perform a 360-degree oblique scan of the area
- Return the camera to the manufacturer recommended position in the final stage before touchdown to prevent damage due to recirculating particles.

(5) Should a person or animal enter the landing zone, the landing shall be paused and/or aborted until a safe landing can be conducted at this or a possible alternate landing site.

(6) The RPAS shall be descended at a slow enough rate that the descent can be paused or aborted if an emergency situation presented itself.

3.5.9 Extended Range BVLOS Launch of an RPAS

BVLOS Take-Offs are only approved by InDro for Day operations.

(1) Prior to launch the VO must scan the airspace into which the air vehicle will be launched.

(2) A Pre-Take Off check will be completed.

(3) The Pilot will announce their intention to launch the RPAS. This will be acknowledged by the remainder of the crew.

(4) All available sensors will be utilized to maintain situational awareness of the area surrounding the RPAS during the ascent.

(5) For operations in controlled airspace, the VO will transmit the RPAS activities to all local air traffic as required by ATC.

(6) For operations in uncontrolled airspace, broadcast call reports will be made at 5-minute intervals.

(7) Once clear, the crew will follow all applicable SOPs during different phases of flight.

3.5.10 Maneuvering BVLOS in a Confined Area

Within InDro, BVLOS manoeuvring in a confined area at night is not approved, therefore this procedure only applies to flight during the day.

(1) The crew will follow previously learned procedures for a high recce and if necessary, during descent, a low recce.

(2) The crew will use all available sensors to monitor the flight of the RPAS and nearby obstructions.

(3) The RPAS will only operate at an altitude and speed that maintains a safe operational margin from people or animals in its vicinity.

(4) Flight of the RPAS will remain at a sufficient distance from people, animals or property required to maintain a safe operational environment.

3.5.11 Dropping a Package BVLOS at a Specific Location

Within InDro, BVLOS dropping of a package at night is not approved, therefore this procedure only applies to flight during the day.

(1) The RPAS crew will follow all applicable SOPs in order transition to and from the location for dropping the subject package.

(2) The pilot will announce to the crew that they have reached the area above the drop location and are ready to descend.

(3) The RPAS camera will be used to scan the area of the drop zone prior to descending in order to determine that the area is clear of obstructions and people.

- Position the camera(s) to provide a NADIR view to scan for obstructions as the aircraft descends
- As the aircraft nears drop height, position the camera to perform a 360-degree oblique scan of the area

(4) The pilot will announce that they are descending to “drop altitude”. This announcement will be acknowledged by the VO.

(5) Once at drop altitude, the pilot will announce “dropping ‘payload’” prior to releasing the load. At a remote location, confirmation the area is clear by the VO is required prior to the pilot releasing the load.

(6) Once the load has been released, the pilot will climb to altitude and again scan the drop area to ensure complete mission status.

(7) The crew will follow all applicable SOPs in order to return home and complete their mission.

3.5.12 Tactical (Low Level) BVLOS Flight

Within InDro, BVLOS night flying is not approved for tactical BVLOS flight, therefore this procedure only applies to flight during the day.

(1) **Flight above and then at the height of obstructions while following directions from the PO.** During flight BVLOS the PO will request that the pilot move the aircraft to improve or anticipate the next photo or video clip. SOPs will be followed to reposition the aircraft while maintaining clearance from obstacles. This will be accomplished at two heights: well above obstacles, 100 ft clearance and again just above obstacles, 20 ft clearance. It is noted that for some systems the pilot takes on the role of PO.

(2) **Flight below the height of obstacles in the vicinity.** This task is similar to the one just above, except that the pilot manoeuvres the UA based on any and/or all information available to him or her. In an urban environment, this task typically would involve moving the UA below the height of building, flags or towers on a city street. Hover and Maneuver accuracy could be affected by crew situational awareness, GPS loss of satellite coverage and environmental / landscape / EMI effects. The variance in accuracy is to be measured in the BVLOS confined area (and its probable cause identified).

3.5.13 Preventing Controlled Flight Into Terrain

Comprehensive mission planning and skilled inflight piloting techniques are fundamental to successful BVLOS mission completion. Section 3.5.2: BVLOS Cross Country Flight Planning, provides details regarding multirotor medium range (5 to 15 NM.) flight planning. Sections 3.5.3 to 3.5.12 present operating procedures that allow the flight crew to transition from VLOS operations to BVLOS operations and back, when flying at medium height (less than 400 ft AGL) and at low height (below treetops and buildings). The role for low flying is surveillance and the supported First Responders are police, Fire-Rescue, Paramedics or SAR. The role of medium height operations is transit, perhaps carrying a package in support of hospital or medical staff.

This subsection introduces the RPAS flight crew to the important skill of avoiding a serviceable RPA from impacting the ground or an obstruction during BVLOS flight.

Throughout VLOS operations Controlled Flight Into Terrain (CFIT) is avoided by maintaining visual contact with the RPA by either the PIC or the VO, and these crewmembers communicate as described in section 3.5.14 below. During BVLOS operations the flight crew maintains a lookout for air traffic and monitors the system displays in a flight following mode. Pilot communication will be relating to progress of the air vehicle along the flight route. Avoidance of CFIT is accomplished through a combination of the following procedures, tips and techniques.

(1) Select the optimal reference for the height to be used for mission planning and the subsequent flight: height above launch, height ASL or height AGL, and ensure that this is suitable for map reading during flight.

(2) Be familiar with device operation and information interpretation.

(3) Prepare a map and use it during flight.

(4) Plan and then go along a route that, in general, follows contours rather than climbs and descends hills.

(5) Plan waypoints with crossing heights selected for the next leg of the route.

(6) During the site survey be especially cognisant of towers, wires and cables.

(7) To support Situation Awareness, plan checkpoints that proceed hazardous terrain elevation changes.

(8) Pre-plan a route to the alternate to avoid potential flight in unfamiliar terrain.

(9) It is mandatory for BVLOS operations to “cross-check and verify” the data entry of the flight data into the mission planning software. It is recommended for VLOS as applicable.

(10) If the operation includes a Payload Operator they may provide additional assistance to the PIC in monitoring height during flight.

(11) If a diversion is necessary, ensure that all turns are “cleared” before commencement to avoid impact with a terrain beyond the pilot-cam field of regard.

(12) If en Route climb performance is in doubt (when approaching rising terrain), slow down or stop, and climb to the transit height.

(13) Stay ahead of the aircraft and, by using a sterile cockpit, avoid distractions.

(14) Actively use pilot decision making techniques, that is, conduct an ongoing risk assessment during the flight.

(15) Fly the aircraft first (or, to avoid CFIT: aviate, navigate, communicate).

(16) Be mode aware, that is, be cognisant of commanded flight controller descents.

(17) Give terrain and obstructions a wide berth.

(18) If the weather deteriorates, divert early; avoid get-home-itis.

(19) Fly with precision: on course, on height, on speed, all the time.

3.5.14 Pilot – Visual Observer Communication Procedures

(1) During the pre-flight briefing the PIC-VO communication protocols will be discussed.

(2) Prior to deployment, communication equipment will be verified serviceable.

(3) During the site set-up the communication equipment will be tested.

(4) The PIC will use a single-ear headset if the VO is to be deployed.

(5) If the VO has been deployed, the VO will read the pre-take-off check over the comms device.

(6) The PIC will call “clear” over the comms device.

(7) When airborne the PIC will advise the VO when his or her VLOS limits are approached.

(8) When the PIC commences FPV flight the VO will be told of the change in control methodology.

(9) The VO will continue to advise the PIC when the RPA approaches air traffic, obstacles, persons or terrain.

(10) If the PIC wishes to give the VO control of the flight path the PIC will advise “You have the conn” to which the VO will respond “I have the conn”.

(11) The VO will then direct the PIC using “positive control” techniques to keep the RPA clear of aircraft, obstacles and/or terrain while remaining within the pre-planned flight geometry for the operation.

(12) The PIC will rotate his or her body to continually face the direction of the airborne RPA.

(13) As the RPA continues on the pre-planned route beyond visual line of sight of the VO the VO will advise when the RPA is proceeding out of VLOS.

(14) The PIC will then take back control with the words: “I have control”.

(15) The VO will respond with: “you have control, I am monitoring the airspace for air traffic”.

(16) If an intruder aircraft is detected, the VO will tell the PIC (e.g.): “aircraft detected, 1 o’clock far and high”. The position will be relative to the direction the PICis facing and include height context to indicate level of urgency. A broadcast radio call for deconfliction is at pilot discretion.

(17) The PIC will avoid the air traffic in accordance with 2.3.10,whilst at the same time advising the VO of the manoeuvre undertaken.

(18) Once the aircraft is departing the area the VO will report: “aircraft clear”.

(19) As the RPA proceeds back to the Home location, and when the VO gains visual contact, the VO will announce: “RPA within line of sight”.

(20) The PIC will acknowledge with the word “Roger”.

(21) If the PIC decides to pass the conn to the VO, the PIC will say: “you have the con”.

(22) The VO will respond with the words: “I have the conn” and will provide positive control to the PIC to maintain separation from aircraft, terrain and

obstacles while at the same time completing the mission.

(23) Once the PIC decides to retake control the PIC will use the words: “I have control, eyes down” or “I have control, eyes up”.

(24) The VO will respond with: “you have control”, and continues with standard aircraft, terrain and obstacles separation duties.

(25) When the PIC commences VLOS flight (eyes up) the VO will be told of the change in control methodology and the flight will continue using standard VLOS SOPs.

3.6 SELECT FIRST RESPONDER PROCEDURES FOR REMOTELY PILOTED AIRCRAFT SYSTEMS

3.6.1 Terrorist HAZMAT RPAS Procedure

General

The following procedure should be followed if an Emergency Response RPAS Team is called upon to respond to a perceived terrorist incident involving threatening packages either within the Postal or Courier Service, or left abandon in a strategically sensitive location.

Function Analysis

The top-level functions associated with this procedure are as follows:

(1) Respond to request for support;

(2) Transit by vehicle to incident site;

(3) Establish contact with Incident Commander or representative;

(4) Establish RPAS base of operations;

(5) Respond to IC requests;

(6) Pack-up and return to RPAS home base; and

(7) Complete documentation and storage of equipment.

Response Procedure

Respond to request for support

(1) Allocate RPAS roles and responsibilities amongst team members;

(2) Produce abbreviated Site Survey, Emergency Contingency Plan and Security Plan;

(3) Acquire TAF, METAR and NOTAMs;

(4) Develop flight plan;

(5) Create polygons and/or waypoints for auto-flight;

(6) Advise ATC/FSS of potential operational requirements; and

(7) Conduct Pre-Flight Crew Briefing flow.

Transit by vehicle to incident site

(1) Determine ETA;

(2) Verify equipment on board;

(3) Drive to incident site;

(4) Identify other supporting RPAS units;

(5) Initiate identification of RPAS operating locations upwind of incident;

(6) Identify secondary landing locations;

(7) Top-up batteries as required;

(8) Configure battery charging station for extended operations; and

(9) Gather all available information.

Establish contact with Incident Commander or representative

(1) Listen out on operational radio nets;

(2) Determine location of Incident Command Post;

(3) Communicate with ICP via runner, telephone, radio, etc.; and

(4) Provide operational status.

Establish RPAS base of operations

(1) Park vehicle at RPAS base of operations;

(2) Identify suitable operating area;

(3) Complete Site Setup flow in accordance with SOPs;

(4) Complete RPAS Setup flow; and

(5) Establish internet connectivity for streaming video.

Respond to IC requests

(1) Provide RPAS support alternatives as required;

i. Liaise the IC regarding RPAS support,

ii. Provide alternatives as appropriate,

(2) Support Size-Up;

(3) Provide video for assessment of structural strength of damaged building(s);

(4) Provide ongoing situational awareness;

(5) Provide 4-gas detector video feedback;

(6) Deliver (drop) lifesaving supplies to persons in need;

(7) Provide high recce;

(8) Provide streaming video, and commentary to EOCs and PREOC as requested;

(9) Inspect IC established perimeter;

(10) Support establishment of ingress routes;

(11) Support evacuation;

i. Assess escape routes,

ii. Identify choke points and barriers to egress,

(12) Geolocate persons in distress;

i. Provide IC with high resolution imagery,

ii. Provide IC with thermal imagery,

iii. Provide IC with low light imagery,

iv. Provide IC with “zoom” imagery,

v. Provide a geo-reference for persons in distress,

(13) Provide Point of Interest video; and

(14) Provide Waypoint flight profile and real time video.

Pack-up and return to RPAS home base

(1) Respond to IC release of RPAS asset to return to home base;

(2) Decontaminate team and equipment as required; and

(3) Complete Pack-up Flow.

Complete documentation and storage of equipment

(1) Provide Interim SITREP to Emergency Response Manager;

(2) Complete general action report for release by Emergency Response

Manager;

(3) Complete Debrief Flow; and

(4) Back-up data.

3.6.2 Social Disturbance RPAS Procedure

General

The following procedure should be followed if the Emergency Response RPAS Team is called upon to respond to a social disturbance.

Function Analysis

The top-level functions associated with this procedure are as follows:

(1) Respond to request for support;
(2) Transit by vehicle to incident site;

(3) Establish contact with Incident Commander or representative;

(4) Establish RPAS base of operations;

(5) Respond to IC requests;

(6) Pack-up and return to RPAS home base; and

(7) Complete documentation and storage of equipment.

Response Procedure

Respond to request for support

(1) Allocate RPAS roles and responsibilities amongst team members;

(2) Produce abbreviated Site Survey, Emergency Contingency Plan and Security Plan;

(3) Acquire TAF, METAR and NOTAMs;

(4) Develop flight plan;

(5) Inquire regarding News or other First Responder air traffic;

(6) Create polygons and/or waypoints for auto-flight;

(7) Advise ATC/FSS of potential operational requirements;

(8) Conduct pre-mission pack-up flow, including verification of payloads; and

(9) Conduct Pre-Flight Crew Briefing flow.

Transit by vehicle to incident site

(1) Determine ETA;

(2) Verify equipment on board;

(3) Drive to incident site;

(4) Identify other supporting RPAS units;

(5) Initiate identification of RPAS operating locations with appropriate vantage for long range monitoring of incident;

(6) Identify secondary landing locations;

(7) Top-up batteries as required;

(8) Configure battery charging station for extended operations; and

(9) Gather all available information.

Establish contact with Incident Commander or representative

(1) Listen out on operational radio nets;

(2) Determine location of Incident Command Post;

(3) Communicate with ICP via runner, telephone, radio, etc.; and

(4) Provide operational status.

Establish RPAS base of operations

(1) Park vehicle at RPAS base of operations;

(2) Identify suitable operating area;

(3) Complete Site Setup flow in accordance with SOPs;

(4) Complete RPAS Setup flow; and

(5) Establish internet connectivity for streaming video.

Respond to IC requests

(1) Provide RPAS support alternatives as required;

i. Liaise the IC regarding RPAS support,

ii. Provide alternatives as appropriate,

(2) Support Size-Up;

(3) Provide video to allow assessment or investigation of:

i. Key instigators,

ii. Property damage and fire potential,

iii. Injured parties,

iv. Strategic movement of the crowd, and

v. Crowd migration into hazardous confined areas;

(4) Provide ongoing situational awareness;

(5) Provide high recce;

(6) Provide streaming video, and commentary to EOCs and PREOC as requested;

(7) Inspect IC established perimeter;

(8) Support establishment of ingress routes;

(9) Geolocate persons in distress;

i. Provide IC with high resolution imagery,

ii. Provide IC with thermal imagery,

iii. Provide IC with low light imagery,

iv. Provide IC with “zoom” imagery,

v. Provide a geo-reference for persons in distress,

(10) Provide Point of Interest video;

(11) Provide Waypoint flight profile and real time video;

Pack-up and return to RPAS home base

(1) Respond to IC release of RPAS asset to return to home base;

(2) Secure confidential media; and

(3) Complete Pack-up Flow.

Complete documentation and storage of equipment

(1) Provide Interim SITREP to Emergency Response Manager;

(2) Complete general action report for release by Emergency Response Manager;

(3) Complete Debrief Flow;

(4) Back-up data;

4 CONCLUDING MATERIAL

4.1 GENERAL

For decades SOPs have been the touchstone that flight crews have relied upon to allow them to fly their aircraft safely and with the confidence needed for mission completion. Whether the sortie is a maintenance test flight, cargo carrying mission, passenger transfer, involves effects or simply recce, procedures contribute to a well-functioning crew that complete their work, document lessons learned and sets things ready for the next mission. Procedures are a hallmark of good airmanship/airwomanship, not only the procedures themselves, but also the dedication to effectively use the advice recorded by pilots who have gone before.

These SOPs have been prepared to describe the way in which InDro will operate their RPAS under the Advanced Operator designation. The SOPs, flows and checklists contained herein are specific to the InDro RPAS and operating philosophy.